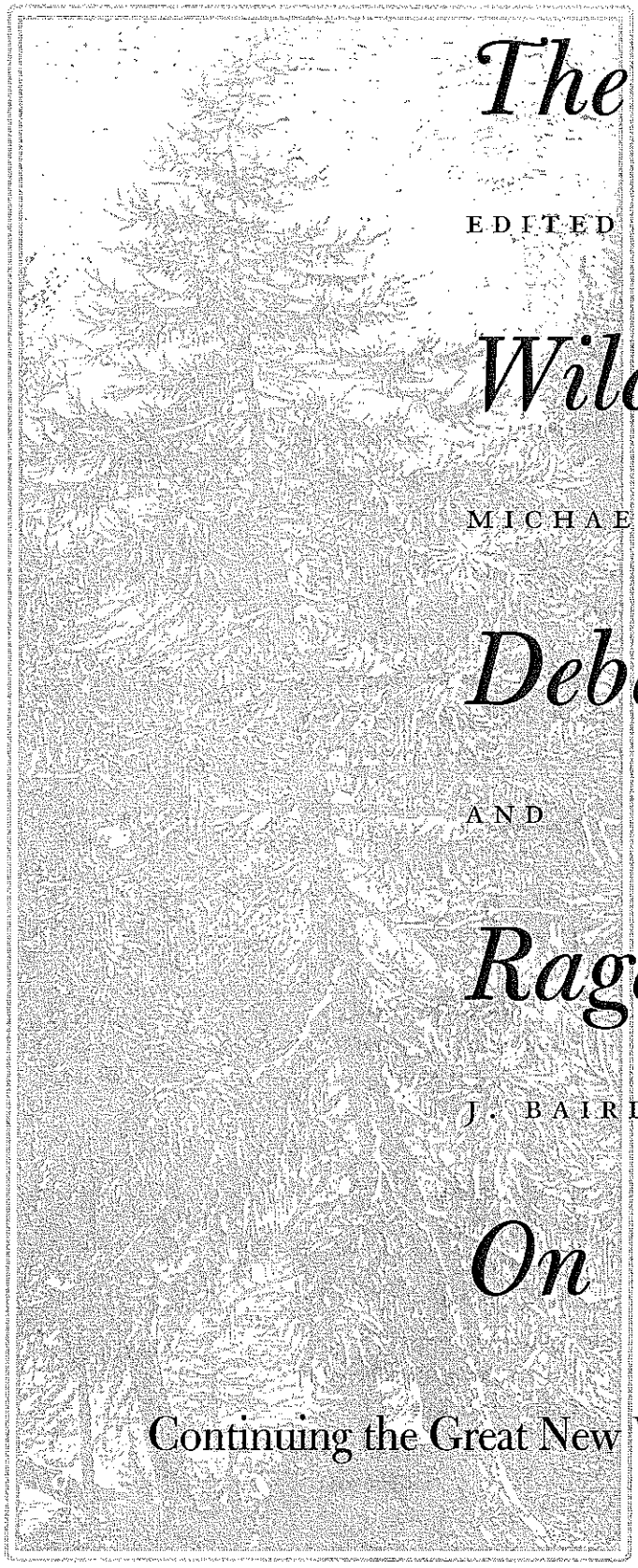

The Wilderness Debate Rages On

EDITED BY

MICHAEL P. NELSON

AND

J. BAIRD CALLICOTT

Continuing the Great New Wilderness Debate

THE UNIVERSITY OF GEORGIA PRESS ATHENS AND LONDON

Kurt Jax and Ricardo Rozzi

Ecological Theory and Values in the Determination of Conservation Goals (2004)

Examples from Temperate Regions of Germany, United States of America, and Chile

INTRODUCTION

A SIGNIFICANT NUMBER AND diversity of people and institutions today agree about the necessity of conservation (Primack et al. 2001). However, in spite of this general agreement, defining conservation goals is a complex issue and there is much disagreement on the question of what to conserve and, moreover, how this should be done. At the same time, current globalization and large-scale ecological, economic and social problems make it necessary to set precise goals for conservation actions (Figueroa & Simonetti 2003).

Setting aside some areas and leaving them alone, protecting them by drawing lines or even fences around them is not enough (Pickett et al. 1997, Armesto et al. 1998, Bruner et al. 2001, Liu et al. 2001). First, environmental problems are no longer purely local or regional, but they have now an important global dimension (Chapin & Sala 2001). For ex-

ample, atmospheric changes induced by humans, such as the Antarctic ozone hole or global warming due to greenhouse gases, are problems that affect and concern the planet and society as a whole (Vitousek 1994). Even more, the causes and consequences of those changes are often spatially uncoupled, they do not stop at national boundaries, and they may lead to sequels of hitherto unknown dimensions (Rozzi & Feinsinger 2001).

A second reason to argue about the direction of conservation efforts is that it is becoming increasingly evident that conservation cannot be done against the will of the people and/or by completely excluding them from protected areas, but only by including them (Alcorn 1991, Shaxson 1991, Toulmin 1991, Rozzi et al. 2000). The lack of participation by local communities has been a major cause of failure in many conservation projects (Abu Sin 1991), and at the same time, the rights of indigenous people and the value of traditional ecological knowledge has gained increasing recognition (Mark 2001), especially after the 1992 Earth Summit (Jardin & Kares 2000).

We argue that conservation questions cannot be delegated to science alone because they are also questions of values for at least three reasons: (1) humans are affected by conservation actions (Alcorn 1991, Armesto et al. 2001), (2) the role of humans within conservation must be discussed in the face of conflicting social interests (Jardin & Kares 2000, Rozzi et al. 2000), and (3) conservation essentially concerns our moral attitudes toward human and non-human nature (Callicott & Nelson 1998, Callicott 1999).

This paper analyzes the role of ecological science and social values in the definition of conservation goals and discusses the difficulties of this definition. In particular, we discuss why nature alone cannot provide unequivocal guidelines and how ecological theory can contribute to defining conservation units and criteria. Going beyond the traditional role of ecology as a provider of empirical data and predictions, we emphasize the hitherto neglected heuristic role of ecological theory in clarifying conservation goals and connecting facts and values.

We provide a historical introduction on the origins of protected areas in two Northern Hemisphere temperate countries, Germany and the United States, as two contrasting models. Following this, we examine

conservation criteria and policies involved in the protected areas of the southernmost forests of the world, the Magellan archipelago of Chile. We compare the Chilean case with the Northern Hemisphere cases, as well as with more recent conservation approaches involving zoning and regulation of human activities within protected areas. These examples display a wide range of possible conservation approaches and the values implied within them. Building on these experiences, we finally discuss a novel approach for defining conservation goals, derived from ecological theory and ecosystem management concepts, which may help clarify the goals and the interface between societal decisions aud scientific knowledge.

EXPERIENCES FROM THE NORTH: HISTORICAL AND RECENT CONSERVATION GOALS IN GERMANY AND THE UNITED STATES

Conservation efforts and the establishment of the first protected areas started in both Germany and the United States in the nineteenth century. However, the main emphasis of conservation and the kinds of areas that were protected differed strongly on the two sides of the north Atlantic (Table 1).

The first protected area in Germany, established during the 1830s, was the Drachenfels, a hill with an old castle ruin towering above the banks of the Rhine south of Bonn. The reason to protect it as a natural monument (Naturdenkmal) was the danger of a complete destruction of the castle and the mountain side pointing toward the Rhine by a quarry, which had already caused part of the old ruin to collapse. Later the area was greatly extended to include the surrounding hills in the nature protection area (Naturschutzgebiet) in Siebengebirge. Both the hills of the Siebengebirge and the Drachenfels ruin, however, had a high symbolic value in the context of romanticism and the search for national identity in Germany, which at that time was divided into many small more or less independent states.

The broader conservation movement in Germany was articulated and driven toward practical and political relevance most effectively by

Table 1 The beginnings of nature conservation in Germany and the USA.

	Germany	USA
First protected area	1830s: first natural monument (Drachenfels) Later extended to first nature conservation area (Naturschutzgebiet Siebengebirge)	1872: first national park (Yellowstone)
Main emphasis of early conservation	Cultural landscapes, Protection of resources	Wild landscapes, Protection of resources
Role of humans	equilibrium including humans	equilibrium excluding ("modern") humans

the musician Ernst Rudorff. Inspired by the traditions of romantic art and skilled in writing, Rudorff became the major spokesman of the new idea of conservation (Knaut 1990). This conservation idea started not as a movement to protect "wild" landscapes, but as "Heimatschutz" (Dominick 1992, Knaut 1993), which meant the protection of the home country or home landscape (the "Heimat"). This was essentially the protection of cultural landscapes, that is of landscapes molded by centuries of extensive use practices.

"Heimatschutz" was an explicit reaction against the rise of industrialization and urbanization in Germany. It expressed the desire to secure what was conceived of as the historical identity of the German nation, which during Rudorff's time had already existed as a unified state since 1871. Thus in its first decades, conservation was mainly Heimatschutz and the conservation of natural monuments, a word coined explicitly as a parallel to cultural monuments, meaning extraordinary singular features of nature like particular old trees or remarkable rock assemblages.

An additional emphasis of early conservation in Germany was the protection of natural resources, e.g., birds (but only "useful" birds; see Berlepsch 1899) or game (Rozzi et al. 2001). Human beings were not excluded from conservation but, as major agents of the development of the rural landscapes, they were included in the idea of "Heimatschutz,"

however only as far as they dwelled in traditional, non-industrial lifestyles.

In contrast to the German model of "Heimatschutz," conservation efforts in the United States emphasized the protection of "wild," "untouched" landscapes, pursuing the "wilderness" ideal of Henry David Thoreau and John Muir (Nash 1982, Oelschlaeger 1991). The first park in the United States (state park at that time) was the Yosemite Valley in the Sierra Nevada of California, established in 1864 by the state of California. Later, in 1890, Yosemite was declared a national park (Runte 1997).

The first national park in the United States was established in 1872, namely Yellowstone National Park, which also constituted the first national park of the world. Moreover, Yellowstone can be considered the prototype of all national parks and has shaped this notion (Runte 1997, Sellars 1997). The area is situated in the northern Rocky Mountains of the United States, mostly in the state of Wyoming, and covers an area of almost 9,000 km^2. It protected the wild landscape, which was perceived as not used and altered by humans. The main features which led to the establishment of this park were its magnificent landscapes, including many geothermal features—geysers and hot springs—and abundant wildlife, including attractive large mammals, such as grizzly bears (*Ursus arctos*) and elk (*Cervus elaphus*).

Following the idea of wild landscapes, humans were explicitly excluded or at least considered irrelevant for the current appearance of the protected landscapes. This does not, however, imply that national parks were meant to exclude human visitors. The founding law of Yellowstone stated explicitly that the Park was created "for the benefit and enjoyment of the people." Still today the criteria of the International Union for Conservation of Nature and Natural Resources (IUCN 1994) for the establishment of national parks explicitly require restricted public access. Besides protecting wild nature, another emphasis of early American conservation was—as in Germany—the protection of natural resources, particularly forests, a current connected with the name of the forester Gifford Pinchot (see Norton 1991).

The American idea of preserving wild nature has become very popular and has been the inspiration of conservation systems in southern

South America (see below). However, what is often forgotten is the fact that national parks were never meant to completely exclude people.

SIMILARITIES BETWEEN GERMAN AND NORTH AMERICAN MODELS OF CONSERVATION

Evident differences place early conservation strategies in Germany and the United States at opposite ends of a gradient: culturally molded nature versus wild nature. At the same time, however, there are also important similarities between conservation approaches in both Northern Hemisphere regions, and those similarities have even become more apparent as knowledge about the conditions that prevailed in nineteenth century North America increase.

As in Germany, the establishment of protected areas in the United States was a reaction to the growing impact of humans on the landscape. In North America, human impact was not as much industrialization and urbanization, but the extensive land use that reached the "untouched" western areas of the continent. In addition, the natural heritage of the wild and magnificent landscapes, protected in parks, was considered part of the identity of the American nation, as a substitute for the longer cultural heritage of the European nations (Nash 1982, Runte 1997).

During the twentieth century the early conservation aims were criticized in many respects (e.g., as being too narrow or too conservative), and were changed in that course. The German tradition of conserving cultural landscapes was soon extended to particular (rare) species of plants and animals, which often depended on these habitats, and later to the protection of wild landscapes. In 1970, almost 100 years after the establishment of Yellowstone National Park, the establishment of national parks began also in Germany with the creation of the Bavarian Woods National Park, the first German national park. Today, there are 13 national parks in Germany, with a few more in the stage of planning or negotiation. It is important to note, however, that to date most German parks do not fulfill the strict IUCN-criteria, which demand that at least 75% of the area should be completely free of human use.

Especially in the last decade, the traditional approach of German conservation has been criticized as being too conservative and antiquated, turning nature into a museum with species. Further, many of those species would not occur in those protected areas without human influence, and they will not survive without the perpetuation of these old practices or their substitution by other forms of active management. This debate is still prevailing.

On the other hand, in the United States the notion of "untouched" nature has been seriously challenged (see Callicott & Nelson 1998). Recent ecological, anthropological, and geological research has demonstrated that the landscapes of North America were not in a "pristine" state when Europeans arrived (Russell 1980, Callicott 1999). First, the North American indigenous population was on the order of millions (Diamond 1999). Secondly, the notion of American Indians as "noble savages" or "homo oecologicus" which had no significant impact on the natural setting has turned out to be an idealization. That simplified notion is as false as that of an almost "empty" country, waiting to be taken over by the white intruders (Mann 2002). The pendulum has swung back so far that some scholars see almost every landscape as influenced by land use practices of American Indians (e.g., Kay 1994; see Vale 1998 for a criticism). Similar doubts about the factual basis of the western wilderness idea have also been expressed for other parts of the Americas (e.g., Gómez-Pompa & Kaus 1992).

Under this perspective, Yellowstone or other American national parks would also be "cultural landscapes," if they are to be protected as "vignettes of primitive America," i.e., in the state which the first Europeans found them (as proposed in an influential paper by Leopold et al. 1963). In this case, humans, with their traditional land use practices would be included in American national parks as much as in traditional German "Naturschutzgebieten." However, both the American and the German ideal would exclude modern man as a valid actor, avoiding industrial and urban development in Europe, and non-indigenous European settlers in the United States.

In contemporary conservation strategies the seeming (and sometimes real) contradiction between the German and United States contrasting conservation philosophies becomes even less relevant. Several concepts

have been developed aimed at reconciling conservation and human needs, which propose the design of protected areas including different zones subject to different intensity and type of human use. Hence, different conservation concepts—such as those of the contrasting German and United States traditions—would apply to different zones of a protected area.

The zoning criterion is an essential component of the Biosphere Reserve concept launched by UNESCO through its Man and Biosphere (MAB) program in the 1970s. Each biosphere reserve includes three distinct zones: (1) core zone, strictly dedicated to protect "wilderness," which involves complete exclusion of human activities (except regulated scientific research); (2) surrounding buffer areas, which are defined to permit or even foster traditional forms of land use which, in turn, may be essential to conserve the culturally-founded diversity of habitats and species associated with those traditional practices; (3) transition areas, where productive and other economic activities and infrastructure are permitted (Jardin & Kares 2000).

In southern South America, zoning criteria have been implemented as a means to reduce user conflicts by the Argentinean administration of national parks in Patagonia (Martín & Chehébar 2001, Salguero 2001). Each Argentinean national park includes five zones: (1) strict conservation areas, where human activity (except for scientific research) is forbidden; (2) extensive public use zones, where extensive uses such as scientific, educational, tourist and recreational are permitted; (3) intensive public use zones, which are relatively small areas where intensive tourism and recreation is allowed, including associated service infrastructure such as hotels, lodges, restaurants, camping facilities; (4) natural resource use zones, where sustainable productive activities and indigenous people's residences are allowed; (5) special use areas, which are small areas for administration, services or human settlement not related to public use.

Strategies based on zoning criteria can provide a valuable bridge between opposite notions associated with the wilderness–United States or the cultural-landscape-German conservation traditions. The zoning approach seems to us particularly suited for regions, such as southern South America, which maintain heterogeneous mosaics of landscapes

regarding the degree of human influence. The extreme south of Chile, for example, includes a broad diversity of ecosystems that range from pristine (i.e., wild) to completely man-modified (i.e., cultural) landscapes (Rozzi 2002).

CONSERVATION AND PROTECTED AREAS IN SOUTHERN CHILE

Only four years after the creation of Yellowstone National Park in United States, the first Latin American protected area was established in Mexico. The creation of the Mexican Reserva Forestal Desierto de los Leones, was followed by the Reserva Perito Moreno in Argentina (1903), and the Reserva Forestal Malleco in Chile (1907) (Ormazabal 1988). Since then the number of national parks, state and private reserves has significantly increased in Chile (Armesto et al. 2001) and throughout Latin America (Primack et al. 2001). Today, the Chilean state maintains 92 protected areas, which includes 32 national parks, 47 reserves, and 13 national monuments (Table 2). The area protected by these 92 units represents 19% of the Chilean land surface, which almost triples the mean of 6.4% for South American countries (Armesto & Smith-Ramírez 2001).

Among Chilean administrative regions, Magallanes exhibits an outstanding 7,079,285 ha of protected land, which represents roughly 50% of the region. National parks cover 4,732,785 ha, which represent 53% of the total area devoted to public national parks in Chile. Magellanic reserves comprise 2,346,189 ha, i.e., 42.6% of the area of reserves in the entire country. Therefore, Magallanes has the highest rank of protection in Chile, concentrating nearly 50% of the country's protected land. At the same time, such a large amount of protected land emphasizes the importance of the Magellanic region as a reservoir of non-fragmented temperate ecosystems for Chile and the world.

In spite of the large proportion of protected land, current figures and conservation approaches in Magallanes present several problems. First, the country's distribution of protected areas is very biased toward the extreme south (Armesto et al. 1998). Administrative regions Eleventh (Aysén) and Twelfth (Magallanes), which extend between 44° and 56° S,

Table 2 Protected Areas in the southernmost Administrative Region of Chile, Magallanes.

Category	Name	Province	Area (ha)	Percentage relative to total Protected Area in Chile
National Park (Total in Chile: N=32; 8,912,724 ha)	Bernardo O'Higgins	Ultima Esperanza	*2,962,420	33.2%
	Torres del Paine	Ultima Esperanza	242,242	2.7%
	Pali Aike	Magallanes	5,030	0.1%
	Cabo de Hornos	Antarctica	63,093	0.7%
	Alberto d Agostini	Antarctica	1,460,000	16.4%
	Sub-total		4,732,785	53.1%
Reserve (Total in Chile: N=47; 5,503,499 ha)	Alacalufes	Ultima Esperanza	2,313,875	42.0%
	Laguna Parrillar	Magallanes	18,814	0.3%
	Magallanes	Magallanes	13,500	0.2%
	Sub-total		2,346,189	42.6%
National Monument (Total in Chile: N=13; 17,669 ha)	Cueva del Milodon	Ultima Esperanza	189	1.1%
	Los Pinguinos	Magallanes	97	0.5%
	Laguna de los Cisnes	Tierra del Fuego	25	0.1%
	Sub-total		311	1.8%
	Total Magallanes		7,079,285	49.0%
	Total Chile		14,433,892	100.0%

For each category the total numbers (N) and total area in Chile are given in parentheses. The extreme right column calculates the percentage that each Magellanic protected area represents relative to the entire country.

*This figure corresponds to the area of the National Park Bernardo O'Higgins included in the Region of Magallanes. The total area of this national park is 3,525,901 ha, but 563,481 ha are included in the Region of Aysen, north of Magallanes (Data from Muñoz et al. 1996).

include more than 80% of the Chilean protected land. Hence, large protected areas in Magallanes should not hide the lack of protection in other critical regions of Chile.

A second problem arises from the scarcity of park personnel: less than 20 park rangers work permanently in Magallanes. This yields a mean of one park ranger per 3,540 km^2. This is a common problem in Latin America, where a dramatic situation also occurs in the Brazilian Amazon, which has only 23 permanent park rangers for the whole basin, i.e., an average of one park ranger per 6,053 km^2 of protected land (Primack et al. 2001). This situation contrasts with the United States, which has 4,002 permanent park rangers, that is an average of one park ranger per 82 km^2. The majority of protected areas in Magallanes also lack proper infrastructure, such as means of transportation, which are indispensable in this archipelago region. This lack of transport and personnel determines that not a single park ranger works in the diverse habitats included in the 1,460,000 ha of the National Park de Agostini—the second largest of Chile. Therefore, most protected land in Magallanes, as is the case in other regions of Latin America, would fall within the label of "paper parks" (Rozzi & Silander unpublished results). In fact, Magellanic national parks do not fulfill the requirements and the criteria of IUCN (1994) for this category of protected areas.

A third problem in the Magellanic region arises from the almost complete disregard for local people living close to protected areas, and in some cases indigenous residents have been displaced from their land (Rozzi et al. 2000, Rozzi 2002). The United States preservationist paradigm, sketched above, has had a strong influence on the conservation approach in the extreme south of Chile. The debate about the influence that pre-Columbian cultures had on their local ecosystems and regional landscapes, and the integration of indigenous people into conservation areas is as intense and controversial in South America as in North America. This discussion involves two extreme positions: (1) one that idealizes aboriginal people as living in harmony with nature; and (2) another that considers native people as threats that should be removed from "pristine" or "natural" landscapes. Both are misleading oversimplifications (Alcorn 1991). Regarding the first position, it would be interesting to evaluate the work done in southern Chile by the Ger-

man missioner and anthropologist Martin Gusinde, who was deeply concerned about the future of the Fuegian Indians. In his monumental ethnographic work, Gusinde describes in detail several concepts and practices of traditional ecological knowledge of Kaweskar, Yahgan, and Selknam, indigenous people at the austral extreme of South America (see Gusinde 1946, 1961). Regarding the second position, it follows a preservationist approach identified with John Muir (see Norton 1991), which has been strongly influential for conservation designs in Latin America during the last 130 years (Rozzi et al. 2001). In southern Chile, indigenous populations have been excluded from national parks. For example, the national parks of Chiloé, Bernardo O'Higgins, and Cape Horn have respectively excluded Huilliche, Kaweskar, and Yahgan communities. Interestingly, today the general trend of abandonment and human exclusion in protected areas of southern Chile is changing due not only to conceptual changes about the role of humans as ecosystem components (McDonnell & Pickett 1993, Rozzi et al. 1994), but also to a growing interest in ecotourism.

Ecotourism is promoting a shift, which instead of emphasizing a preservationist approach, underlines the statement "parks are created for the benefit and enjoyment of the people," asserted in the founding law of Yellowstone National Park. In the extreme south of Chile, this statement (which is closer to the United States conservation tradition identified with Gifford Pinchot, see Norton 1991), is acquiring a prevalent role today. This shift toward ecotourist activities requires, however, careful examination in order to achieve a sustainable compatibility between conservation and human needs or benefits (di Castri & Balaji 2002, Figueroa et al. 2003).

Between Yellowstone National Park and the Magellan national parks, in particular Torres del Paine National Park, some remarkable similarities exist. In the Magellan Region, Torres del Paine National Park constitutes an area that, like Yellowstone, possesses marvelous landscapes (including glaciers and mountain peaks), and attractive megafauna (including species like rheas, *Pterocnemia pennata,* and guanacos, *Lama guanicoe*). Also, like Yellowstone, Torres del Paine is visited by a large number of tourists. Although the number of visitors to Torres del Paine (43,624 in 1995) ranks two orders of magnitude below Yellow-

stone (more than 3 million in 1995), for Chile it holds the largest number of foreign visitors and it has a substantial impact on the development of the nearby city of Puerto Natales (Villarroel 1996). Of the visitors to Torres del Paine, 62% are from overseas, coming from Europe (37%), North America (15%), and Oceania (10%) (Ferrer 2001).

Torres del Paine National Park was created in 1959, and was designated as a Biosphere Reserve in 1978. Like Yellowstone National Park, the Torres del Paine landscape shows signs of human influence. The austral landscape exhibits the marks left mainly by European colonists that arrived at Magallanes at the beginning of the twentieth century (Dollenz 1991). Before the Chilean government acquired the park, it belonged to German ranchers who burned large expanses of forests to increase pasture area, which was later overgrazed (see Martinic 1984). Therefore, in spite of the goal to protect pristine or "wild" areas, the imprints of both indigenous and European settlers, are present even in the remote austral regions of the American continent.

Within this context ecotourism poses complex puzzles to conservation biology. On the one hand, it seems to favor a larger integration between society and protected areas. On the other hand, with current deficiencies in the planning and regulation of ecotourism within parks, such as Torres del Paine, undesirable environmental impacts may follow (Villarroel 1996, Massardo et al. 2001). Hence, a close collaboration among government offices, tourism agencies, and academic institutions is required for the planning of protected areas, and defining their conservation goals.

HUMAN VALUES, SCIENCE, AND THE DETERMINATION OF CONSERVATION GOALS

The short overview of conservation strategies in Germany (protection of cultural landscapes), the United States (wilderness ideal), and southern Chile (preservation paradigm, and the more recent interest in ecotourism as a potentially sustainable economic activity) illustrates the broad spectrum of conservation goals and the different role of humans within conservation. Consequently, it is not always clear what exactly should

be protected within reserves or national parks. However, with increasing human pressure on nature, especially in a period of a rapidly growing global economy, and an increasing probability of human-induced global changes, the necessity for a conscious decision about conservation aims and measures becomes greater. Confronted with this scenario, and a broad range of conservation goals: what should we protect? What roles should humans play in this context? Where can we find guidelines? What is the role of science?

Answering these questions requires us to systematically integrate multiple aspects that influence any conservation strategy, aspects that hitherto have in part been developed independently from each other (Jentsch et al. 2003). Such integration has not been achieved, and it challenges the prevailing trend of specialization that dominates science and other disciplines since the second half of the twentieth century (Rozzi et al. 1998). Hence, to interconnect diverse aspects of conservation, such as empirical data, ecological theory, human values and worldviews, represents an urgent and important task. At the same time, this task demands novel theoretical and practical approaches.

Values enter the determination of conservation goals in many different ways: in our images of nature (Ahl & Allen 1996, Rozzi 1999, Rozzi 2003), in our economic values (Daly & Townsend 1994, Daily 1997), in our political preferences (Norton 1991), in our moral attitudes toward human and non-human nature (Rolston 1990), and even in our decisions about what is important in science. However, values are often not explicit and remain hidden behind seemingly objective scientific facts or economic necessities.

The provision of empirical data is one of the basic tasks of ecological research within conservation. It is necessary to describe the current conditions of an area or—by means of, e.g., paleoecological analyses—to restore its "original" or "natural" conditions, e.g., in terms of plant cover or animal life. However, criteria for selection of particular areas and their subsequent management are not purely based on scientific knowledge.

What kinds of data are collected and what kinds of questions are asked is already a matter involving value decisions. Although many people argue that, for conservation purposes, ecology should simply

identify the "natural" condition, this task is far from a purely "objective" scientific enterprise. For example, the concept of what is natural plays a major role when deciding which role humans should play within protected "natural" areas. Both the German and American early conservationists wished to protect "natural" landscapes although their images of what is "natural" differed considerably. In addition, these concepts have changed during the following decades and they still have different meanings for different groups of people. Particularly difficult questions related directly to value decisions arise today with respect to alien plants and animals (invasive species) entering an area and spreading there. Should they be considered as "natural"?

Ecological theory is a third important and often neglected ingredient in the determination of conservation goals, which can serve two main purposes. First, ecological theory allows us to go beyond a purely static description of an area, by providing insights into the interactions between the elements of ecological systems, their dynamics, and the ways they might respond to external changes. Ideally, ecological theory should provide the means for predicting the development of ecological systems.

A second, much less considered role of ecological theory is its heuristic use in the formulation of research questions and conservation goals (Jax 2003). Ecological theory can help identify gaps in our knowledge and expose uncertainties. Even more important within conservation, ecology can help clarify our questions, forcing us to be more precise about the concepts we use. Although this remains a difficult task, ecological theory can also help distinguish between values and facts and promote their integration in the definition of conservation goals. We illustrate this point using one of the currently most discussed approaches to conservation, the strategy of ecosystem management.

PRESERVING ECOSYSTEMS: THE SOLUTION TO CURRENT CONSERVATION DILEMMAS?

Ecosystem management represents an increasingly popular strategy, which is compatible with a dynamic view of nature (Christensen et al.

1996). It recognizes ecosystems as permanently changing and, at the same time, promotes a multiple use perspective.

The management of whole ecosystems—in contrast to that of single "commodities"—seems to be an elegant solution to many conservation problems. By protecting the whole ecosystem, we avoid protecting only certain parts of an area at the cost of others. This approach, to our knowledge, was first applied systematically in Yellowstone National Park, starting in the late 1960s (Jax 2001, 2002b). During the 1990s the notion of ecosystem management experienced a rapid rise in North American environmental policy (Grumbine 1994, Christensen et al. 1996, Boyce & Haney 1997, Jax 2002b).

In contrast to its beginnings, in which ecosystem management was mainly a particular way of dealing with complex natural settings, the notion has now been extended to an ambitious societal program (Jax 2002b). Although the ecosystem approach in the United States means very different things to different people (Yaffee 1999), some common ground is emerging. The ecosystem is used here as a cipher for the treatment of "the whole," a whole that also includes humans, their societies and resource use practices. Moreover, it emphasizes interagency management and a focus on natural boundaries in contrast to administrative ones (Grumbine 1994, Carpenter 1995, Szaro et al. 1998). In this context, the ecosystem and ecosystem management concepts are becoming strongly value-laden, departing from the perspective of "value-neutral" science.

It is this ecosystem approach which is applied by the Convention on Biological Diversity (CBD). The Fifth Conference of the Parties of this convention, which took place in Nairobi in 2000, passed a resolution that recommended the "ecosystem approach" as a cross-cutting issue for the CBD and obliged all parties to implement this approach within their conservation policies (resolution COP V/6). Based on the so-called Malawi-Principles, the approach emphasizes the social dimensions of management and that societal choices have to be made. It also acknowledges the changing nature of ecological systems (Botkin 1990, Pickett & Ostfeld 1995, Plachter 1996).

The ecosystem approach is considered a major tool for implementing the three basic goals of the CBD, namely biological conservation,

sustainable use of natural resources, and equitable sharing of benefits (Smith & Maltby 2001). However, the implementation of such an approach is far from simple. First of all, it is an illusion that we would really be able to grasp the whole. This is an epistemological problem (Pickett et al. 1994, Rozzi et al. 1998). To investigate anything in nature, we have to select and isolate a particular characteristic of interest, from which we mentally form the system which we then describe and analyze. This has direct consequences for the scientific perception of the ecosystem as the very object of the ecosystem approach. In spite of some "naive-realistic" attitudes, an ecosystem is not a natural entity that can be identified in nature without reference to particular interests and selection criteria (Jax et al. 1998). It is defined in a task-specific manner. Definitions of ecosystems are manifold (Jax 2002a), and those that are commonly accepted as embracing the many and contrasting meanings are, in consequence, very general, too general to provide clear criteria for defining the goals of ecosystem management.

To implement an effective approach to ecosystem management it is necessary to: (1) set a baseline, (2) define what an ecosystem is, and (3) have criteria to decide when it is "destroyed" or deviates significantly from a baseline condition.

For example, the case of southern Chile might involve questions such as: are the subantarctic evergreen rainforest ecosystems characterized by a particular species composition or just by a particular physiognomy of plant and animal types? Has the invasion of the North American beaver (*Castor canadensis*)—which started in the late 1940s on Tierra del Fuego, Navarino island and other areas of the Cape Horn archipelago (Lizarralde & Venegas 2001)—created new and more diverse ecosystems? Today, is *Castor canadensis* part of the "old ecosystem" or is it the destroyer of the "original ecosystems"? Will we say that an ecosystem has become "another" ecosystem if some native undergrowth species are lost (or replaced by alien species) or will the ecosystem only be "another" if its physiognomy is also changed?

The ways in which ecosystems are defined must be communicated in a clear manner. However, this is still frequently not done, generating difficulties at different levels. To serve this communication purpose, Jax and collaborators (Jax et al. 1998, Jax 2002a) have recently devel-

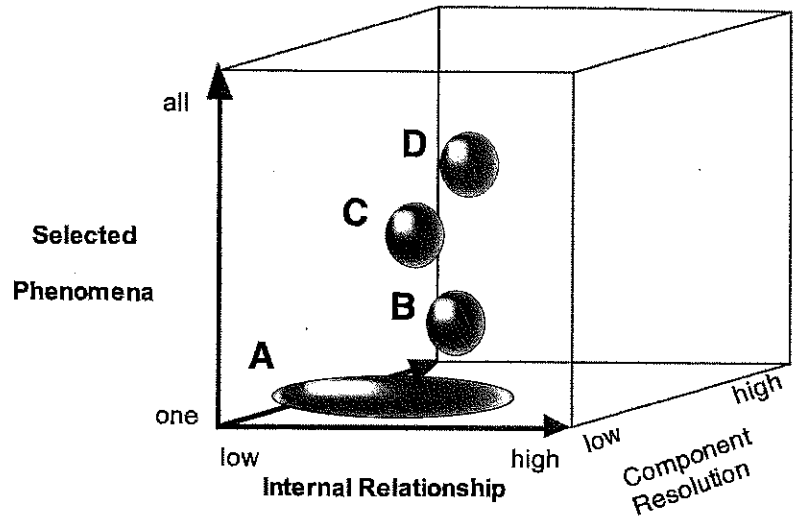

Figure 1. Representation of different definitions of "ecosystem" that are applied in ecosystem management strategies (see text).

oped an approach to clarify and provide an unambiguous definition and specification of any ecological unit. To do this, statements are needed about: (1) whether the unit is bounded topographically or functionally, (2) which kind of relationships among the components are minimally required, (3) which phenomena (i.e., components and internal relations) are selected for the definition of the unit, and (4) what is the degree of resolution of the unit's components.

The first criterion represents an essential distinction. It describes an element (e.g., organism) either seen as a part of a unit by virtue of being in a particular spatial location or by virtue of being functionally (i.e., by interactions) related to other elements. For example, within the bounds of a *Nothofagus* forest on an austral island, are all species components of one ecosystem or are there several separate ecosystems characterized by specific functional connections within these topographical bounds?

The remaining criteria apply to both spatially and functionally bounded units. They can be seen as gradients, which can be assembled as three axes into a graphical scheme that allows visualizing the different definitions (Fig. 1).

The axis of selected phenomena displays which and how many phenomena (kinds of objects and/or processes) are included in the definition of the ecosystem. The axis of internal relationship indicates the de-

gree of intensity and specificity that internal relationships are required to have in order to call a unit an ecosystem, or even an intact ecosystem. In some definitions, for example, the requirements to call a system an ecosystem are such that interactions have to be very specific and lead to an equilibrium state, or that feedback-loops are present which lead to the self-regulation of the system (high internal relationships). In other definitions any interactions between the organisms (low internal relationships) are sufficient to call the system an ecosystem. The axis of component resolution describes to what degree the components of the ecosystem must be resolved, e.g., whether the system parts are considered at the species or just trophic levels. Based on the initials of the three axes (selected phenomena, internal relationship, component resolution) this scheme was named the "SIC-scheme" (Jax 2002a). Fig. 1 displays this general scheme to illustrate some of the most common meanings of ecosystem in the context of ecosystem management.

These meanings vary according to the conservation aims. The most general definition is depicted by the ellipse "A." Here the ecosystem is preserved simply as a system of interacting natural objects. Indeed, the interactions themselves may be the focus of management (which can also mean to refrain from active management). The kinds (i.e., species) of organisms are not of special importance here (low component resolution), and the degree of required internal relationships might also vary. For example, particular feedbacks may be demanded within the system to call it an ecosystem, such as the criterion that most primary production must occur within the system itself. This kind of ecosystem may be useful for the management of wilderness areas, even in regions that have been strongly impacted by humans but where now "nature can take its course." This is an especially interesting concept for ecosystem management in central European countries, where completely "pristine" areas no longer exist.

Sphere "B" (Fig. 1) depicts another frequently applied definition of ecosystem, which focuses on particular interactions and processes. Here, the ecosystem is described by particular functional compartments, interacting in a manner that particular services—such as primary production, clean air or waters—are provided by the system. Component resolution is thus slightly higher than in type A, but still particular spe-

cies are not of interest, only functional types. The degree of interaction is higher than in many other definitions because interactions, and particular feedbacks, between specific functional elements are essential for the definition. This kind of definition is sufficient when the aim of ecosystem management is to provide benefits for humans in the form of "ecosystem services" (Costanza et al. 1997).

Sphere "C" (Fig. 1) depicts a third type of ecosystem definition that demands a higher resolution in the three axes. For example, a *Nothofagus* forest ecosystem or a *Sphagnum* bog and the essential interactions that perpetuate such systems are to be protected. The aim is to protect a large ecosystem which is "typical" for the area, without the necessity that all constituent species have to be preserved in the long run, except for some conspicuous and dominant taxa such as *Nothofagus* trees and *Sphagnum* mosses. Particular types of taxa (indicator species, keystone species or "umbrella species"; see Simberloff 1998) are thus already part of the definition. This—physiognomic—view of ecosystems is perhaps the most common one in the practice of conservation and resource management.

Finally, sphere "D" (Fig. 1) illustrates a concept of ecosystem defined by all species occurring in a setting. Interactions themselves are protected mostly for the sake of conserving the interacting components. These may be those species which are present in a protected area at a date t (e.g., the date at which the measures start) or—much more difficult to determine—all species which are considered as "typical" for a particular site. The aim here is to perpetuate all species, without fixing particular growth rates or dwelling places, abundances, or specific ratios between species. Everything, besides the species composition, is in a condition of waxing and waning, including local disturbances and recolonizations (within the system). This aim is formulated, for example, in some national parks and corresponds to the current strategy of ecosystem management in Yellowstone national park (Jax 2001).

CONCLUDING REMARKS

Based on the concise examination of conservation approaches that have taken place in temperate regions of Germany, the United States, and Chile,

followed by the analysis of conservation units based on the SIC-scheme, what can we learn for conservation in the austral Magellanic region?

First, conservation traditions encompass interests for the preservation of both natural and cultural heritages. Even more, these two dimensions are mutually dependent, as shown by the "natural areas" of Yellowstone and Torres del Paine, which have been molded in part by humans. Therefore, nature and humans are brought together in the object of conservation, as well as in the processes occurring in the protected units. Consequently, the dichotomies between nature and culture, and between protected areas and human presence, become irrelevant.

Second, in the context of current global change it is impossible to completely isolate protected areas from human influences (Primack et al. 2001). Human impacts can arise as much from local populations (for example, firewood extraction) as from remote populations inhabiting a different hemisphere, as in the case of the austral ozone hole caused by the emissions of chemicals in Northern Hemisphere industrialized countries. Moreover, in the three temperate regions considered, humans as components of ecosystems may be a "keystone species." In addition, a dynamic view of nature—the "flux of nature"—points out that biotas and ecosystems will change over time, even within "protected areas." Hence, to preserve species or habitats it is not enough to "isolate" protected areas, but often it requires active management and conservation.

The two former conclusions invite us to revise the conservation approach undertaken in the extreme south of Chile, where local people have been excluded from protected areas, and where the National Forestry Service (CONAF, the organization responsible for these areas) has serious logistic and financial limitations to carry out conservation and/or management programs.

Third, our analyses demonstrate that conservation goals involve not only scientific criteria, but also philosophical, political and broader cultural, social and economic dimensions. Hence, interdisciplinary and interagency cooperation is urgently needed. None of these actors can see or understand the "whole" by themselves. Therefore, operational definitions of the units and goals of conservation need to be jointly defined.

This process requires explicitly presenting the goals, methods and values involved in conservation or management of species and ecosystems.

Finally, we consider that the ecosystem approach to conservation, as currently conceptualized within the guidelines of the CBD, represents an extremely valuable tool. It allows integrating solid empirical research, sound ecological theory and human value dimensions. However, it is important to avoid the pitfalls that these approaches can have, when unproductive and improper mingling of facts and values involve a fuzziness of basic and practically relevant theoretical concepts, such as the ecosystem concept. These problems could undermine the usefulness of the ecosystem approach, concealing the issues really at stake. In this context, ecological theory, embedded in interdisciplinary work and social participatory processes, represents an indispensable key element for determining conservation goals.

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